ORIGINAL

IN THE UNITED STATES DISTRICT COURT

FOR THE NORTHERN DISTRICT OF OKLAHOMA

THE CITY OF TULSA, et al.,)
)
Plaintiffs,)
)
vs.) CASE NO. 01-CV-900-EA
)
TYSON FOODS, INC., et al.)
)
Defendants.)

VOLUME II

TRANSCRIPT OF DAUBERT HEARING

HAD ON MARCH 4, 2003

BEFORE THE HONORABLE CLAIRE V. EAGAN

UNITED STATES DISTRICT JUDGE

APPEARANCES:

For the Plaintiffs:
MR. KENNETH N. McKINNEY
MR. ROBERT L. ROARK
McKinney & Stringer, PC
101 North Robinson, Suite 1300
Oklahoma City, OK 73102-5504

MR. R. BRENT BLACKSTOCK
McKinney & Stringer, PC
401 South Boston, Suite 3100
Tulsa, OK 74103

For Tyson Foods and Cobb-Vantress:
MR. ROBERT W. GEORGE
Kutak Rock, LLP
214 West Dickson Street
Fayetteville, AR 72701-5221

MR. McDANIEL: No, Your Honor.

THE COURT: All right. Thank you, Doctor. You may step down.

Any further witnesses on behalf of defendant?

MR. McKINNEY: Could we have just a minute to see if we have anything in rebuttal, if they're finished?

THE COURT: Are you finished?

MR. McDANIEL: Defendants are finished, Your Honor. Thank you.

THE COURT: All right. Let's see if the plaintiff has anything further.

MR. McKINNEY: Could we have just a minute?

THE COURT: Yes.

MR. McKINNEY: Your Honor, plaintiffs have nothing further.

THE COURT: Okay. Now, Dr. Engel, let me ask you this: Do you need time to go gather your thoughts on your opinions, or are you ready now to give your opinions?

DR. ENGEL: I think I'm ready now.

THE COURT: All right. Would you come forward to be sworn, please.

DR. ENGEL: Should I bring all of these materials?

THE COURT: Bring your stuff, anything you think you'll need.

BERNARD ENGEL, COURT'S WITNESS, SWORN

DIRECT EXAMINATION

BY THE COURT:

Q All right. Dr. Engel, you have been advised that you are the Court-selected expert in this case for the purposes of this hearing, correct?

A Yes.

Q And you received a packet of information from me that was roughly the size of two very full red rope folders, and I'll represent to you that I received those jointly submitted from the parties. Have you had an opportunity to review all of those materials?

A Yes, I have, and I believe they are all here.

Q Let me ask you -- oh, did you also receive the document which is three pages entitled "The Role of the Court-Appointed Expert"?

A Yes, I did.

Q Did you understand that to be your charge in this matter?

A Yes.

Q I'll state for the record that that was Exhibit 1 to the joint submission of requested instructions to Court-appointed expert that is filed of record as of February 5th, 2003.

A I did ask, or I believe I did talk with you about a clarification on that.

Q Yes, and I'll get into that in just a second. Did you review that document?

A Yes.
Q After you reviewed that document, did you call me to ask for clarification?
A Yes, I did.
Q And specifically was that on page 2, starting in B, where they use the word "hypothesis"?
A Correct.
Q And what was your question to me?
A The hypothesis was not defined within this document, and I did not want to assume what the author or authors of this meant by hypothesis here.
Q Do you recall what I advised you?
A Yes.
Q And what was that?
A You indicated that the hypothesis here was that Dr. Storm and his modeling effort were able to identify and attribute phosphorous to various sources or identify the phosphorous loading and attribute that to various sources.
Q Well, more generally, did I not advise you that you could use the word "hypothesis" as similar to, if not the same as, opinion?
A That's correct as well, yes.
Q And that you were to look at Dr. Storm's opinions contained in his expert reports and in his deposition testimony?

A Opinions and not conclusions, right.
Q Yes. And I specifically advised you that we were not interested so much in his conclusions but in his methodology in how he arrived at them, correct?
A Right.
Q All right. Understanding that clarification, did you then undertake to fulfill your role as Court-appointed expert?
A Yes, I did.
Q What did you do in addition to reviewing the materials, if anything, to do that?
A I did review some of the SWAT documentation, looked at some additional journal articles that were available about SWAT and other modeling kinds of exercises.
Q All right. And have you also sat in the court now for these two days listening to all the evidence?
A Yes, I have.
Q All right. Now, based upon the work that you've done and hearing the testimony here for these two days, let me first start on the bottom of page 1 of the Role of the Court-Appointed Expert and ask you if you have formed any -- if you have made any findings or formed any conclusions with regard to Dr. Storm's qualifications.
A Yes, I have.
Q And what are those?
A I find that he is in general qualified, based on his

extensive experience, educational background and, you know, the variety of work that he's conducted in this region.

Q Qualified to do what?

A Qualified to offer opinions about hydrology, watershed processes, nonpoint source pollutant loadings.

Q And with regard to any opinions that he has proffered, either in his deposition testimony or in his reports relating to those subjects, do you find that he has the minimal educational or experiential qualifications to present those opinions?

A Yes, I do.

Q Now, I want to ask you with regard to the SWAT model in general, as opposed to just offering opinions about hydrology, watershed processes, nonpoint source pollutant loadings. I want to ask you with regard to the SWAT model in general if you have opinions about the reliability of that model.

A I believe the literature, in my experience, would generally indicate that the model is reasonable, it's a reasonable model for this kind of an exercise.

Q And when you say for this kind of exercise, what do you mean?

A For trying to understand the behavior of a watershed and to do some assessment of the likely sources of phosphorous.

Q All right. Have you used the SWAT model?

A Yes, I have.

Q For how long have you utilized the model temporally?
A Probably about ten years.
Q Have you reviewed all of the documentation that accompanies the model that gives instruction or explanation of the model and how to use its --
A I maybe wouldn't go as far as all, but there is very extensive documentation, so I have certainly reviewed the majority of that, if not all.
Q And for what types of applications have you used the model?
A Generally trying to identify locations that might be targeted for educational efforts, areas that might be targeted for best management practice implementation, trying to understand the likely sources of pollutants within a watershed.
Q With regard to that latter one, likely sources of pollutants within a watershed, have you ever used the model in connection with a court case or any litigation?
A No.
Q Do you know of any court case or litigation where the SWAT model has been utilized to attempt to prove likely sources of pollutants within a watershed?
A No, I do not.
Q Now, are you familiar with what types of agencies or organizations utilize the SWAT model generally?

A Yes.
Q And what are those?
A I believe we heard many of those in the testimony yesterday and today. USEPA is certainly an agency that is using SWAT. They also recommend its use to people developing TMDLs, so it would be various state agencies, consultants that would be doing those. USDA-NRCS is also a significant user of the model, and we also heard that the Army Corps of Engineers is using the model, in earlier testimony today.
Q All right. Now I want to talk specifically about Dr. Storm's use of the model in this case. Let me ask you generally, have you formed an opinion as to whether Dr. Storm has the education and experience to utilize the SWAT model?
A Yes.
Q Are you personally aware that he has used it in the past other than what you've gleaned through review of the documents or learned from sitting here?
A I believe, based on my professional experience and interaction, in looking at literature in the past, that, yes, I was aware that Dr. Storm has used the model in the past in significant ways.
Q All right. Now I want to talk particularly about his use of the SWAT model in this case. And first I want to talk about his use of the SWAT model to predict total annual P loading to Lake Eucha. Have you formed any opinions about the

reliability of his output as a result of his use of the model?
A Yes, I have.
Q All right. Would you tell us what opinion or opinions you hold in that regard.
A In this particular instance, the SWAT model was calibrated such that it would predict the annual loads to the lakes, so because of that one would expect that for that calibration period it would match fairly well the observed data, the observed phosphorous loadings into the lakes.
Q And did it?
A Yes.
Q All right. Have you formed any opinions as to the reliability of his output with regard to annual total phosphorous loading?
A It's difficult to -- it's difficult to place a degree of reliability on that, given that the model was not validated.
Q All right. Could the model have been validated as to total P loading given the data that was available?
A In my opinion, I think there were some ways that he could have done that, and we've heard some of those discussed in earlier testimony. You know, potentially he could have taken the years of data and broken those up, using part of that for calibration, reserving some of that for validation.
If I recall correctly, there were data that were not used in the calibration, so there were data from gauges that were

not used in calibration. They were deemed to be insufficient numbers of high-flow records, if I recall. That data could have been used in a validation mode.

There were other things that would maybe not be validation but would go toward increasing reliability or belief in the reliability of the results, and many of those were not completed here either.

Q You just heard Dr. Shannon testify with regard to his estimate, if you will, of 35,000 kilograms a year annual loading?

A Yes.

Q And that that's approximately a 25 percent variance from Dr. Storm's 47 or 48,000?

A Right.

Q Can you explain to me in laymen's terms what is the significance of that variance? Does that impact the reliability of the annual P loading output from the SWAT model?

A There were different techniques used in arriving at those two numbers, so I'm not sure that it really says much to me in terms of the reliability of the model in this particular case. It just says that there were different techniques used, they got different numbers.

Q So I don't want to put words in your mouth. Do you believe that the annual total P loading to Lake Eucha from

Dr. Storm's use of the SWAT model is or is not reliable?
A I think it is reliable for the period for which the model was applied. And again, much of that reliability, in my opinion, is based on the observed data that was used to calibrate the model to get those results.
Q And so in terms of predicting the future, however, there would be less reliability for, let's say, the next four-year period because it was not validated?
A Most likely there would be less reliability, but we don't know. The results may in fact be better, but we don't know.
Q Because it's not validated?
A Partially because it's not validated.
Q And the other reason is?
A Just due to inherent uncertainty in weather patterns, processes being represented in the watershed.
Q Now I want to turn to Dr. Storm's use of the SWAT model and his output regarding allocation of source of phosphorous loading to Lake Eucha. Have you formed opinions about -- have you made any findings or reached any conclusions about that portion of his work?
A Yes, I have.
Q All right. And what is that?
A I think the model is being used to provide best estimates, with the data used, with the assumptions made, as to the source of the phosphorous. My concern is the

reliability of those estimates. I think there is potential for a great deal of uncertainty around those estimates.

Q Tell me why.

A There would be a number of reasons, and if I can refer to some of my notes.

Q Yes.

A Maybe we can start with validation. Validation would have given me additional confidence in the reliability of the results that we get in attributing sources to -- phosphorous sources to various land uses or to various sources. So the validation was one of the factors.

Secondly, there's a fair amount of uncertainty in many of the inputs that have been used within the model, and we've heard about a number of those during the testimony and from earlier witnesses. There are others that, in my opinion, are maybe even more significant that were not identified.

Q Would you tell us what those are, please.

A The land use data was derived from remotely sensed data. I have no problem with that approach. My concern is that, at least based on the materials I reviewed, there was not an accuracy assessment of that land use data set. And a typical procedure when deriving land use data from remotely sensed data would be to perform an accuracy assessment.

So to accomplish that you would reserve part of your groundtruth data, you would estimate land uses given whatever

technique is being used, and then you would use some of that groundtruth or ground reference data to compare estimated with predicted.

In many instances with remotely sensed data, accuracy assessments will suggest that the land use that you get from that process is maybe 80 percent accurate, maybe it's 90 percent accurate, and if you're really fortunate it might be somewhat better. In this case we don't know how good that is.

Q All right. What other areas -- was that just an example of areas of uncertainty that have not been identified? Are there others?

A Yes, that was an example of one of the areas of uncertainty that was not identified that potentially in this case could be somewhat significant. It may not be.

Q Have you identified others?

A Yes.

Q All right.

A In this particular -- best management practices were not represented in as full a manner as they might have been. I certainly understand, you know, the time, the resource and other constraints.

Indirectly, some of the best management practices were represented through the USLE -- or MUSLE P factor that we've heard about in earlier testimony, but there was not a very direct representation of many of the best management

practices. In many instances best management practices can significantly alter the P loads that we might get, but yet those are largely unknown, unquantified in this particular case.

Q All right. Have you identified any other areas?

A We heard about certainly other parameters, other sources of uncertainty in much of the testimony. I can repeat some of them that in my opinion are more significant than others, if you would like.

Q Yes, please.

A Okay. We've heard about numerous other potential sources of phosphorous loading in the watershed. Probably the one that is of most concern to me is the hogs. If I recall correctly, the phosphorous from the hogs might represent 10 or 15 percent of the total -- is it 10 or 15 percent of the total phosphorous? Or maybe 10 or 15 percent of the phosphorous with respect to the chicken litter. Dr. Storm at the time made the assumption that was not significant enough to include in the model. In retrospect my guess is he may, you know, may wish to modify that assumption if he were making an additional model run. But that, in my opinion, increases the level of uncertainty in the identification of sources.

It would have been preferable if there had been a written policy, a written protocol before conducting the modeling that would have clearly identified, you know, what the thresholds

are, you know, what the decision-making process is going to be as to whether things are included, whether things are excluded.

Q Let me ask you this: Do you draw a distinction between the reliability of the identification of sources generally as opposed to trying to estimate percentage allocation by land use?

A Could you repeat that, please?

Q Yes. A hydrologist can look at a watershed and the uses of the land in the watershed and determine generically the potential sources of phosphorous in the watershed, correct?

A Right.

Q And what I'm trying to do is to distinguish between Dr. Storm's review of potential sources in the watershed and then his opinion regarding allocation by land use. Do you see a distinction between the reliability of those two factors?

A When you exclude some of the potential sources, you have to end up attributing some of this phosphorous that does end up at the lakes to sources that you did include. So that increases the uncertainty, decreases the reliability of some of those estimates.

Q Based upon what you know today, if you were going to run the SWAT model in this watershed, would you include the hogs as a contributing factor?

A I think I probably would.

Q Would you include humans?
A I probably would not.
Q Any other species or factors that were not included by Dr. Storm that you would include?
A I think there are other factors. We've talked some about the BMPs. We've not talked about some of the soil phosphorous levels. I think there are some things there that could have been done that would have increased the reliability or increased the -- or decreased the uncertainty around some of the modeling results.
Q Can you give me some examples of that, please?
A We talked about this earlier with -- or heard about some of this earlier from some of the testimony. Certainly a sensitivity analysis, varying the soil phosphorous levels and observing what happens in the model response would be helpful. Some of that was done I believe in Storm 1, if not maybe even Storm 2. There was an opportunity maybe to carry that a little further to better -- to better identify the impact of some of those kinds of assumptions and how those would impact how you attribute the phosphorous sources.
Q All right. Anything else that you think could have been done or should have been done to either increase your confidence level or to make the output more reliable?
A I think I'm done with the data at this point. Can we move on?

Q You want to turn to assumptions?
A Yes, can we move to other --
Q Yes.
A Okay. Calibration, let's maybe talk about calibration a little bit. The method used for calibration, you know, was certainly one that has been used, continues to be used, will continue to be used by various scientists, by various people trying to use this model or other models like this.

It would have been preferable in this particular case to have had a written protocol before calibration. I think that would have headed off a lot of the concerns that have been raised about the calibration process. You know, as it was presented, the technique that was used seems to be a little bit ad hoc. But as I said, that's a fairly widely accepted sort of technique within the scientific community.

But in my opinion, when we are going to be concerned about reliability of model estimates, it would have been preferable to have a written protocol, a written quality assurance kind of plan for that process.

Q And as you sit here today, because there wasn't a written protocol, but you have reviewed the calibration techniques that were used, are you saying that the failure to have a written protocol significantly impacts your opinion on reliability?
A It impacts -- I'm not sure that it would be significant.

But it does -- it does raise that potential question about reliability.

Q All right. Now, you talked about data, you talked about validation, you talked about calibration. Any of the assumptions that were made by Dr. Storm that you have an opinion about?

A Many of the assumptions I think are assumptions that many people using SWAT would make. You know, there are other assumptions that probably -- you know, different people would make different assumptions.

Q Does anything about his assumptions impact your opinion on reliability of his output as it relates to allocation of sources?

A I believe there are some assumptions in this that would favor the defendants. There are other assumptions that would favor the plaintiffs. As a result, it really makes it difficult to understand how reliable the results may be when trying to attribute phosphorous to given sources so that the uncertainty around that is sufficiently large that it just, you know, it just makes it very difficult to say very clearly that, yes, I believe that this particular source is responsible for X percentage.

Q So would you restate in your own words your bottom-line opinion of the output of Dr. Storm's modeling work as it relates to allocation of sources.

A In my opinion, there is significant uncertainty associated with the allocation of sources. We have estimates of numbers based on his best interpretation of data, his best use of the model, but due to some of the factors I talked about there remains a significant uncertainty in how much faith we can really put in attributing phosphorous to specific sources, or at least attributing specific percentages to specific sources.

Q With regard to the sources themselves, forget the percentages for a minute, would you agree that the sources he identified by land use, without having been to the watershed or reviewed the land use, but if you assume what you heard here and what you've read is true, would the sources identified by Dr. Storm be accurate, subject to the factors we heard on cross-examination on the things that he left out?

A Yes. I believe, you know, probably the relative ranking of sources is maybe, maybe not too bad. There is still a fair amount of uncertainty within that, but, you know, the relative ranking of those is maybe not too bad. But again, realize that there are some sources that have been left out, many of those probably not very significant in the end. In my opinion, maybe, you know, maybe swine is worth looking at, but, you know, it's certainly not going to rise to the level of many of the other sources that have been included.

Q You had me ask some questions of Dr. Shannon with regard

to what could have been done to either increase confidence or certainty in the results.

A Right.

Q Do you have an opinion about some of those factors you had me ask him about?

A Yes, I do. So maybe you could ask those again.

Q Let me dig those out.

A Okay.

Q All right. The first one was, without validation, are there other ways to increase confidence in the reliability of model results?

A And I think, you know, clearly there are some ways to do that.

Q All right. And one is parameter sensitivity analysis?

A There was limited parameter sensitivity analysis that was conducted here. I would have liked to have seen more of that. I would have liked to have seen, and I think Dr. Shannon spoke a bit to this, that it would be interesting to see what happens if we do take the defendants' chicken litter numbers and apply those at face value, see what the model predicts. There are many other assumptions of that sort or many other alterations of some of the data that could be made to explore how those propagate through the model and what net impact on the results that may have.

Q All right. What if you ran another model and then

compared the output of the other model to the results of this model?

A That again would increase the belief that, if they did match -- so assuming that there was a reasonable match between the two models, that would increase one's confidence in the results that are obtained with the SWAT model or with any other model.

Q All right. And finally, what if you bias the parameters in favor of defendants and examine the model output?

A One of the most effective approaches that I've seen used in court cases with models is to parameterize the model, provide input data in such a way that the data, the assumptions tend to favor the defendants. Run the model, examine the results. If your conclusions based on those are fairly consistent with what, you know, your best estimate of what reality is, there's certainly much less room to argue about what is happening within the watershed or what is happening with the pollutants in that particular case.

Q I'm still, I'm not going to say troubled, I'm not going to say unsure, but I'm still not totally clear about the total P loading on an annual basis and the model output, the results that Dr. Storm got. When I see -- and I don't really know in advance of the trial how significant a difference between an estimation of 35,000 kilograms a year versus 48,000 kilograms a year is to the plaintiff proving its case or not.

But as I sit here as a layperson, those numbers to me seem to be within the ballpark of what different scientists could come up with using their own techniques. They seem to be within an acceptable range to me as a layperson in terms of whether I determine admissibility or inadmissibility of total P loading. Can you expound a little bit more about your opinion on the reliability of the total P loading by year?

A Certainly. In hydrologic modeling, that type of a difference is certainly not unexpected. So, you know, typically we would be -- you know, we would be very accepting of the magnitude of difference you're describing in a hydrologic modeling kind of a world.

In this particular case there was observed flow data, observed phosphorous concentration data that were used to estimate phosphorous loading to the lakes or certainly someplace near the lakes. That data was used in calibrating the model. So therefore the calibrated model, if calibrated well, and it was calibrated, you know, reasonably well I think in this particular case, should provide -- should match that observed kind of data.

So it would not be surprising that you would be able to get the model to estimate the 48,000 or whatever that number might be. So that would be expected.

The uncertainty arises when that was not carried the step further in that we did not validate or attempt to increase

reliability or decrease uncertainty with other techniques.
Q But with regard for the period that was analyzed, did you say before that that number, that output would be reliable?
A That should be a fairly reliable number because it is largely based on observed flow, observed concentration, which was used to estimate observed loadings, which in turn was used in calibration. So whether one looked at observed data or the model estimated loads, those should be fairly similar for the period of observed data.
Q All right. Do you have other opinions that you've formed?
A Can I look at my notes here just a moment? I believe we've hit the highlights.
THE COURT: All right. What I would like to do, it's about 2:20. I would like to take about a ten-minute break to let counsel confer with their experts and their clients. Dr. Engel has to walk out the door at 4:00 o'clock, so that leaves us an hour and a half, 45 minutes each, to ask him anything you want to ask him about his opinions in the case. All right? We'll take a ten-minute recess.
(Recess from 2:20 p.m. to 2:35 p.m.)
THE COURT: All right. Mr. McKinney.

CROSS EXAMINATION

BY MR. McKINNEY:
Q Dr. Engel, I'm Ken McKinney. Nice to meet you after

seeing you for two days in the courtroom, sir.

There's been a lot of talk in this case about the fact that since this is in litigation, we have to look at it in a litigation context or in a context of is this reliable enough to use to prove liability on someone. Do you have an understanding or a belief as to a threshold reliability quantum that may be required in litigation as being possibly different from something done in a normal scientific community?

A My opinion would be that in litigation kinds of circumstances, the reliability is expected to be higher than what we would probably be willing to accept in the scientific community.

Q I was afraid that you had, for whatever reason, that you had that belief, and from some things that have been said, I think that's great that you may have that belief.

If in fact -- and I know you've been given instructions and you weren't given a complete brief of what the cases say about admissibility. But if in fact the law in federal court is that expert testimony is to be freely or liberally admitted if it meets the other qualifications, would that be somewhat inconsistent with what you have come to believe?

MR. McDANIEL: Your Honor, I'm going to object to that hypothetical to the witness as being a legal matter and for the Court's instruction of the expert.

THE COURT: Well, why don't we just do this. Let me ask you this: Dr. Engel, you relied on this three-page document?

THE WITNESS: Yes, I did.

THE COURT: All right. And did you form that conclusion based upon this three-page document?

THE WITNESS: Yes, I did.

THE COURT: All right. So why don't you attempt to see if he has other opinions, if the reliability that is anticipated in this document is the same as scientific reliability.

MR. McKINNEY: And I'm sorry, Your Honor. I just didn't remember if that case that stands for that proposition is included in this three pages. I didn't remember that it was.

THE COURT: No. The only things that were in this submission were Daubert, Joyner, and Kuhmo Tire.

MR. McKINNEY: I thought so, and yet there are indeed other cases that say what I've suggested.

THE COURT: Yes. So feel free to ask him about the standard.

MR. McKINNEY: So if in fact --

THE COURT: Not for a legal opinion.

MR. McKINNEY: No, I understand.

BY MR. McKINNEY:

Q And believe me, I'm not trying to ask you if you agree with the law or anything like that. But what I'm trying to do is get your frame of reference in the opinions and evaluation that you have just submitted to the Court, because if your frame of reference is not exactly correct, then that could have some impact on the opinions that you're rendering.

And again I would ask you to assume, don't take my word for it, but just assume as a fact that the federal law favors liberal or free admission of expert evidence, if it meets the other criteria, and would ask if that was something that you had taken into account, or is this the first time you've ever heard that?

A This is not the first time, so I did, certainly did consider that.

Q Okay. And yet you've been proceeding under the belief that the threshold standard for litigation admissibility was greater than the standard in a scientific setting?

A That was my belief, yes.

Q Okay. And if that is not the case, then you might tend to rethink slightly some of your opinions that you have rendered to the Court?

A I'm not sure they would change that much. In my professional opinion, the report, the materials as I've seen them --

Q Yes.

A -- at this stage would not make it through most academic peer review processes. And the stumbling block is likely to be lack of validation, assumptions made with data sets, with interpretations of things that reviewers may not fully buy into. So much of my conclusion is based on that, which, you know, in fact is not a different threshold.

Q Have you tried to differentiate in this case, in rendering your opinions to the Court in this case, as between a potential disagreement in the outcome of the modeler and the opinion that Dr. Storm may render versus the scientific methodology that he's utilized?

A Could you repeat that, please?

Q Yes. Again, I think one thing that is, I believe is the function of a hearing such as this is not the consideration of whether we agree or disagree with the result or the opinion or the outcome; it's to test the scientific methodology which was used and see if that was properly done and properly applied and so forth.

A I would agree with that statement, and I don't believe that's inconsistent with what I said earlier.

Q Okay.

A Again, the concerns are not based on the conclusions. The concerns are based on interpretation of data that went into the model, assumptions made in setting the model up, and then lack of calibration. So I don't believe those have to do

with conclusions reached with the way the model was used.
Q You've done your best to try to keep those two things sorted?
A Yes, I have.
Q Have you testified in court before, Dr. Engel?
A Not in court, but in depositions.
Q In depositions?
A Yes, sir.
Q In a fairly full-blown testimony so that you got a good dose of it?
A Yes, sir.
Q Okay. It's fascinating in this case, I don't know if you knew it, but Dr. Arnold and Dr. Srinivasan and when he first got into this case Dr. Storm, this was the first matter, legal matter they've ever testified in. You've worked with Dr. Arnold and Dr. Srinivasan?
A Yes, I have.
Q Okay. And is it possible -- let's look at the area of the potential for honest disagreement among experts. Do you find that in the scientific community, that some experts disagree with other experts?
A Oh, certainly.
Q And sometimes they might not be in good faith, but normally you believe, or want to believe anyway, they're just good faith disagreements in judgment that they have?

A Certainly.
Q And you heard Dr. Arnold's testimony and Dr. Gade's testimony and Dr. Srinivasan's testimony that in their opinion the methodology used and the output of the model is reasonably reliable, you heard that?
A I'm not sure they went as far as saying reasonably reliable. I think they stopped short of saying reasonably reliable.
Q Well, in all due respect, the Court in her questioning of them asked them a question, each one of them I think a question along the lines, would you like or would you prefer or would you feel better if you had more data or this additional step or that additional step. Would it not be correct that any scientist is always going to answer that question yes?
A I would say almost all scientists would answer yes.
Q And so that doesn't really tell us whether the work done to date is scientifically usable or not, does it, Dr. Engel, the fact that they would prefer to have more, better, and different data?
A Could you repeat that again?
Q Yes. That standing alone, the fact that someone would say, Of course I would have more confidence in a result if I had this additional step or this additional data or some other element, that doesn't necessarily mean that the results that

that person's study has achieved at that point are not scientifically useful, does it, sir?

A Correct. However, and the "however" is that it does go to the level of belief, level of certainty, level of trust you can place in the results.

Q Okay.

A So that's where the issue is.

Q Do you understand through your litigation experience that the American jurisprudence system relies upon cross-examination to flesh out the truth and allow a finder of fact to arrive at a legitimate decision based upon a factual inquiry?

A Yes.

Q And so the fact that different -- the fact that different experts have different opinions, you understand that that's the role of cross-examination, to try and illuminate what the real evidence is?

A Certainly.

Q And in the inquiry as to what expert evidence is admissible, then you understand that that's a tried and true method which is to be considered and is to be utilized in making sure that the truth ultimately comes out?

A Right.

Q When Her Honor was inquiring of you, and I think I wrote this down correctly, let me see if I did, I think you said --

you were talking about the allocation of sources. You had gone from the first point and she was asking you specifically about the allocation of sources. And in that, are we talking about, okay, within the watershed pastures have -- either you do it with a percentage or you might do it some other way, but pastures have a certain percentage and other areas have -- other land use areas have other percentages of contribution of nutrients to the watershed?

A Right.

Q That's what we're talking about in allocation?

A Right.

Q Okay. And at least I wrote down that you said significant, you had significant uncertainty as to the specific percentage in connection with sources, specific percentage allocation among sources --

A Yes.

Q -- is that correct? And then I thought you went ahead to say that a relative ranking you did not have that level of uncertainty about?

A The level of uncertainty there would be decreased, certainly.

Q Okay. And so if one wanted to evaluate, using the model, what some potential sources were, including their relative ranking but without percentages, you think that would be a different matter than trying to ascribe a certain percentage

to each of those sources?
A I would certainly have more confidence in those relative rankings than specific percentages.
Q Okay. And again that would help cure the issue that you've described about not including hogs, for instance. That was the one other source that you said --
A Right.
Q -- based on what you've seen so far, you would probably include that?
A I probably would at this point. My guess is that Dr. Storm may at this point, given what he's heard.
Q And would it also be fair to say if you were doing this two years ago, based on the information that Dr. Storm had at that time, you might not have included it then?
A I may not have, you're right.
Q Okay. And so in one sense that's kind of the dilemma that we're in here today. We're trying to -- we are trying to help the Court arrive at an appropriate decision, whether there's enough scientific methodology and science applied to this problem, that there is a usable output or usable conclusion to be derived from this study which can further the understanding of the watershed or is usable enough to be considered by a jury. And I suggest that the threshold is not higher, it should not be higher, but again that's not -- you don't have to consider that from me.

You answered many of the questions that there are -- you feel like there are different things that are ways to increase the reliability or increase the comfort and so forth, and it kind of sounded to me like maybe you were helping one of your postdoc students or doctoral students who is coming to you with an assignment and asking you to help him vet his draft paper that he's done. Would that be a fair statement to make?

A Yes.

Q And so you want him or her to get his paper as right as it can be gotten before it's ultimately published, don't you?

A You certainly want to get it to the point that the probability of getting that through peer review is good.

Q Okay. Did you hear Dr. Arnold who said in his opinion that the work that Dr. Storm has done in this case was publishable?

A I'm not sure that he said "was" or did he say "may" be publishable?

Q And you've got me there. I don't remember which word he used, but --

A I think probably "may." Certainly one could find three referees that may review this favorably, but my professional experience is that, you know, without validation -- and if you look in the literature and if you look at Dr. Storm's publications, by far the vast majority of modeling kinds of papers are going to include a validation step.